Dust Mitigation Technology Development for Future Lunar Missions with the Dust Solution Testing Initiative (DuSTI) Project. A. H. Garcia[1], S. R. Deitrick[1], M. C. Sico[2], J. L. Black[3], K. K. John[2], [1]Jacobs Technology, NASA Johnson Space Center, Houston TX 77058, [2]NASA Johnson Space Center, Houston TX 77058, [3]University of Houston – Clear Lake, Houston TX 77058. (angela.h.garcia@nasa.gov)

Introduction: The jagged, hard, and electrostatically-charged dust on the lunar surface is one of the most significant hazards to human exploration of the Moon. The safety of the crew members and sustainability of habitats, science, and supporting hardware depend on effective dust mitigation techniques and technologies. As NASA pursues a new generation of lunar missions with the Artemis program, the Dust Solution Testing Initiative (DuSTI) project is pursuing dust mitigation solutions by performing tests on promising commercial off the shelf (COTS) technologies over FY21.

DuSTI's goal is to increase the technology readiness level (TRL) of COTS technologies by validating components in relevant environments with relevant materials (i.e. lunar regolith simulant). The specific technologies identified for study were selected based on several factors, including a market analysis of current terrestrial dust mitigation applications, availability of the technology, accessibility of various testing facilities, and cost of procurement.

Technology Testing: NASA's official lunar dust mitigation strategy will implement a multi-pronged approach: operational and architecture considerations, passive technologies, and active technologies [1]. DuSTI is focused on passive (non-powered) COTS technology development within three categories: hard good coatings, soft good coating, and pliable cleaners.

Hard Goods Surface Coatings. The substrates of interest for testing are optical surfaces (i.e. polycarbonate and fused silica) and anodized aluminum. We will evaluate the performance of coating adhesion to the substrate, abrasion resistance, and dust adhesion resistance. We will report data on substrate haze and transmission (for optical surfaces), scratch depth via scanning electron microscope (SEM) images, pass/fail coating adhesion via tape press tests, thickness change via micrometer screw gauge, and particle adhesion percentage via optical particle counter.

Soft Goods Surface Coatings. The substrates for this category are candidate spacesuit materials and common intra-vehicular materials. We will evaluate the performance of coating adhesion to the substrate, changes to substrate flexibility after coating, abrasion resistance, dust adhesion resistance, and cleaning easability. We will report data on substrate flexibility pre/post coating via flex tester, particle adhesion percentage via mass change and optical image software analysis of percentage dust coverage change, and abrasion degredation via optical microscopy images and SEM.

Pliable Cleaners. Pliable cleaners are COTS cleaning gel/putty/clays that may gently liberate and store surface contaminates. We will evaluate the effectiveness of various pliable cleaners at removing lunar simulant from hard and soft good substrates for the use case of intravehicular dust mitigation cleaning. We will report data on pliable cleaner simulant saturation, temporal usability, and cleaning effectiveness via mass change and optical image software analysis of percentage dust coverage change; chemical residue via gas chromatography mass spectrometry (GCMS); encapilated particlulate matter via SEM images, and flammability and offgassing via chamber testers.

Future Work: The results of DuSTI testing will be compiled into a technology infusion report in Q4 of FY21 and each year the project is funded. These technologies will be tested using NASA Johnson Space Center, White Sands Test Facility, and Kennedy Space Center test facilities designed to simulate the lunar environments that are expected during the upcoming Artemis missions. DuSTI is aligned to improve upon modern methods of lunar dust mitigation in a variety of lunar surface mission environments, setting the stage for astronauts to address dust mitigation challenges for sustained lunar presence.

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References: [1] Johansen M. R. (2020) *Lunar Dust Workshop, No. 2141.*